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ABSTRACT

The costs of directing additional instructional resources to lower-division instruction is assessed. "Frontloading," or directing additional resources toward lower-division students, was recommended by a national study group because first- and second-year students are frequently taught by junior instructors in large classes in which they tend to be passive participants in the educational process. The cost of frontloading is estimated in terms of additional institutional expenditures for instruction. Attention is directed to: various dimensions of the costing question, reasons why instructional costs tend to be lower at the lower-division level, and data illustrating the extent to which these costs differ by level of instruction at various types of institutions. Two models for making cost estimates are also examined. The first cost estimation model focuses on total direct expenditures for instruction, which are allocated by level of instruction, based on enrollments and on cost-ratios comparing costs per student for the lower, upper, and graduate divisions. The second model focuses on the costs of acquiring the additional faculty needed to provide lower-division students with a learning environment similar to that provided to upper-division students. Steps in calculating costs for frontloading are identified, along with a set of simultaneous mathematical equations. (SW)

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The Costs of Frontloading

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The Costs of Frontloading

In the report entitled Involvement in Learning, a major theme was that of the level of involvement of students in their own education. Because of their interest in student involvement, the Study Group on the Conditions of Excellence in American Higher Education, the authors of this report, expressed concern about the instructional practices to which most lower-division students are subjected. Freshmen and sophomores, or lower-division students, are typically exposed to a higher proportion of large classes and junior instructors than are their upper-division counterparts. Because of the large classes, they are normally passive rather than active participants in the educational process. As a consequence, members of the Study Group recommended that additional resources be directed toward lower-division students in order to create circumstances in which those students would be more actively involved in their educational experience. They refer to this strategy as "frontloading." There was no specification included in the report as to how this might be accomplished, although the major component of such a strategy is obvious--increase the level of instructional resources. However, no indication was given in the report as to the cost that might be incurred in carrying out this recommendation.

In this paper we estimate the cost of frontloading in terms of additional institutional expenditures for instruction. We begin with a brief discussion of the various dimensions to the costing question and a rationale for our focusing on a limited number of those dimensions. We continue with a brief discussion of the reasons why instructional costs tend to be lower at the lower-division level and follow this with data that specify the extent to which these costs differ by level of instruction at various types of institutions.

In the third section of the paper we describe the two models by which cost estimates are to be made. We conclude by reporting the results of estimating these models on the basis of various assumptions for various types of institutions.

General Approach

Conventionally we view institutions of higher education as operating a limited number of programs relating directly or indirectly to the provision of educational services: instruction, academic support, student services, institutional support, and operation and maintenance of the physical plant. Two criteria were employed in deciding which of these programs to examine in order to estimate the cost of frontloading: one, evidence to suggest that there is differential access to resources by lower-division students as compared to upper-division students; two, the likelihood that costs would increase because of the addition of resources in another program. The only program that meets the first criterion is instruction. There may be differential access to resources in other areas--student services perhaps--but there are insufficient data to prove the point or around which one might construct a model.

There are three areas that would likely experience higher costs if additional resources were put into instruction: academic support, institutional support, and operation and maintenance of the plant. Additional instructional resources would most likely take the form of new faculty, which would lead to greater computer use, more bookkeeping in central academic administration, more office space, and so on. Plant related costs would likely be the most significant. Not only would more office space be needed, but the smaller class sizes implied by the additional faculty might well require additional physical facilities and the operation and maintenance thereof. These potential indirect and capital

costs are difficult to model. Since they are marginal costs, they depend very much on the utilization of current capacity. Where utilization is low, the additional costs will be low; where utilization is approaching capacity, the costs could be significant. Representative data on utilization rates are difficult to find. Accordingly, in the first of the two models developed for this paper, we focus entirely on the direct costs of instruction. The second model includes an estimate of a portion of additional plant costs.

The first cost estimation model will focus on total direct expenditures for instruction. In the model, these expenditures are allocated by level of instruction, based on enrollments by level of instruction and on cost-ratios comparing costs per student for lower, upper, and graduate division. This procedure will generate estimates of current expenditures per student by level of instruction for various types of institutions. With these estimates in hand, it is a simple matter to calculate the additional expenditures required to adjust the unit costs per lower-division student. In this approach, then, we will deal only with expenditures, letting the expenditures represent the underlying human and material resources whose deployment affects the educational environment in question.

In the second model, we will focus on the costs of acquiring the additional faculty needed to provide lower-division students with a learning environment more closely resembling that enjoyed by upper-division students. Several types of resources contribute to the provision of instructional services--faculty, other personnel, supplies and equipment, libraries, communication (e.g., printing, telephone), travel, and classroom and laboratory space. The largest single component of the direct cost of instruction is faculty compensation (salaries and fringe benefits). It is not uncommon for this cost component to

constitute 70-90 percent of total direct instructional expenditures. The other direct cost components tend to follow faculty costs; for example, the greater the number of faculty, the higher the costs for telephone, supplies, travel, and so on. While we recognize that we will not have captured all of the costs as a result of concentrating on faculty resources, we are convinced that this approach focuses attention on the single most important policy variable subject to institutional manipulation, and that through this device we can again approximate the additional costs of frontloading with sufficient accuracy as to serve the purposes of this paper.

Data we will examine presently will show the extent to which direct costs on a per-student-credit-hour basis are less for lower-division than for upper-division instruction. The reasons why this is so are straightforward. On average, class sizes and student-faculty ratios are higher at the lower-division level. Lower-division courses are in the main non-specialized courses taken by most students. As a consequence, it is possible to teach these students in large groups, and many institutions have not hesitated to do so. Second, proportionately more junior faculty (assistant and instructor ranks, teaching assistants, part-time lecturers etc.) are used in lower-division courses, leaving a disproportionate number of senior faculty with a higher rate of pay to teach at the upper-division level. In addition, it appears that more supplies and equipment are used on a per-credit-hour basis at the upper-division level.

Data

Among the data required by the first model are per-student or per-credit-hour costs by level of instruction. These costs are usually calculated on the basis of the distribution of faculty effort. Sometimes that effort is determined

simply by faculty teaching assignments. Other times it is determined on the basis of faculty activity analysis surveys. The remaining direct costs of instruction are sometimes allocated to levels of instruction on the basis of faculty effort, and sometimes on the basis of an analysis of the actual resource requirements of the various levels (NACUBO-NCHEMS, 1977).

The most common form of institutional analysis of costs by level yields data on direct costs. Some institutions also calculate full costs by allocating various indirect costs, that is , some or all of the costs of academic support, institutional support, student services, and the operation and maintenance of the plant, to the respective instructional levels. Several procedures are used to generate full-cost figures, including allocation on the basis of the direct costs allocated to each level, the student credit hours taught at each level, the square feet of space assigned to each level, or some combination thereof (NACUBO-NCHEMS, 1977).

For this study, it was deemed appropriate to base cost estimates on direct-cost ratios only. Since most of the data on cost ratios are for direct costs, the accuracy and reliability of the available direct-cost ratios are higher than those for full-costs. These qualities are important because, as we shall see, the results of the model are quite sensitive to the cost ratios used.

While most institutions calculate direct instructional costs per student or per credit hour as a routine matter, most institutions do not routinely calculate such costs by level of instruction. The institutions that are most likely to make the effort required, which is substantial because it is necessary to go through a cost allocation process, are public institutions whose funding is tied in some manner (i.e., by some formula) to their efforts at various levels

of instruction. Most of the available cost data comes from these institutions or from special studies that occur from time to time.

Other data that are critical for the present investigation are total expenditures for instruction and enrollments by level of instruction, which can be aggregated by type of institutions. Fortunately, these data are gathered regularly as part of the annual Higher Education General Information Surveys (HEGIS). They are readily available in an appropriate format in the report, Higher Education Financing in the Fifty States (McCoy and Halstead, 1984); specifically, the national averages that the document provides on expenditures and enrollments by institutional type are just what is needed to drive the first of our two models.

There are some additional data that would be useful to have, but that do not exist in the national data base. These are data on human and physical resources and their deployment by level of instruction. Some data of this nature can be found in institutional and state agency studies. At least there is enough to guide the development of the hypothetical data set that is needed for the second model. Also needed in the second model are faculty compensation data. Fortunately, these data are readily available nationally as part of HEGIS and through the efforts of the American Association of University Professors.

Models

As noted above, two models were developed to examine the costs of frontloading. The first is designed as a kind of "black box" approach that ignores the underlying resource utilization issues and deals directly with expenditures.

The model is possible only because of the data that have been gathered on differences in costs by level of instruction or by level of student.

The conventional wisdom on the difference in unit costs between lower and upper division is perhaps best reflected in Bowen's 1980 work on the costs of higher education. In that document, he reports that the average value across fifteen studies was a ratio of 1.5 to 1, with respect to full costs per student by level of student. In a study currently underway at NCHEMS, analysis of more than 200 data points indicates that that ratio for direct costs per student by level of instruction is about 1.6 to 1 for baccalaureate, comprehensive (non-doctoral), and doctoral institutions, and just over 1.8 to 1 for research universities. The NCHEMS analysis also indicates that the ratio differs substantially by program of study. The highest ratios occur in the physical and social sciences, with lower ratios being typical in the humanities and in education. Programatic differences will not be included in the models that follow, but they should be kept in mind as one assesses the likely costs of frontloading at a given institution.

To run the first model, it is also necessary to know the relative cost of graduate level instruction. Bowen's figures are 2 to 1 for first year graduate students and 3 to 1 for advanced graduate students, again for full costs per student by student level. The figure O'Neill (1971) used in her classic study of productivity in higher education, 3.75, for first year and advanced graduate study combined (for direct costs per student by level of student), is probably too high for certain types of institutions. The current NCHEMS analysis suggests values for combined levels of graduate study, in terms of direct costs per student by level of instruction, of 1.92 for baccalaureate institutions (some of which have a few masters-level students), 2.24 for comprehensive

institutions (where most of the graduate students are at the masters level), 3.50 for doctoral institutions, and 3.83 for research universities. Since the values from the NCHEMS study are the most broadly based and appropriately disaggregated by type of institution, they will be used as the basis for what follows.

First, however, they must be adjusted downward. As indicated, they reflect differences in costs by level of instruction. The other data available for the model, however, include only total expenditures and enrollments by level. Thus the cost ratios must be adjusted to reflect differences in costs by level of student. These differences will necessarily be less than those by level of instruction because students at one level sometimes take courses at another level. For this study, we have reduced each of the upper-division and graduate cost ratios by 10 percent. This may be conservative; Gibson (1968), for instance, found that at one research university the upper-division cost ratio by level of student was 12 percent lower and the graduate cost ratio 25 percent lower than the corresponding cost ratios by level of instruction. (His level-of-instruction cost ratios were relatively high, however, especially for the graduate level; his estimate for graduate cost by level of student, 3.3, is slightly lower than the 3.45 figure, or 3.83 x .9, that is used in what follows.) By contrast, across 11 institutions in Ohio in 1983-84, upper-division students took about 17 percent of their credits at the lower-division level, while graduate students took only 4.5 percent of their credits at the undergraduate level (Jones, 1985), suggesting rather different adjustment factors than those indicated by Gibson's analysis. Broadly based measures of average behavior in this regard are not available, unfortunately, so the model will be run using the assumption of a 10 percent adjustment as noted earlier.

With the cost ratios in hand, we can derive estimates of the costs of frontloading in a direct and simple way. The process, or model, has six steps:

1. Obtain data on total expenditures for instruction for the unit of analyis (a single institution, a group of like institutions, and so on).

2. Obtain data on enrollments by level for the unit of analysis.

3. Use the cost ratios to derive a set of simultaneous equations which, when solved, yield estimates of costs per student by level of instruction.

4. Calculate total costs by level of instruction using the data in steps 2 and 3.

5. Combine alternative cost figures for lower-division students, reflecting various policy assumptions (e.g., that lower-division costs per student will equal 80 percent of upper-division costs per student, with the enrollment data in step 2 to generate new total expenditure figures.

6. Subtract the old total expenditure figures from the new ones in step 5 to generate an estimate of the cost of frontloading.

The set of simultaneous equations is derived in the following fashion:

Let E = total instructional expenditures

L = number of lower-division students

U = number of upper-division students

G = number of graduate students

u = the ratio of upper- to lower-division costs per student

g = the ratio of graduate to lower-division costs per student

X = expenditures per lower-division student

Y = expendiutres per upper-division student

Z = expenditures per graduate student

The equations are as follows:

$$Y = uX$$

$$Z = gX$$

$$E = LX + UY + GZ$$

By substitution:

$$E = LX + UuX + GgX$$

And by transposition:

$$X = E/(L + Uu + Gg).$$

Once the value of X, the cost per student of lower-division instruction, is known, the remaining costs by level can be calculated and the model run (starting at step 4 above).

The second type of model focuses on human resources, their utilization rates, and their prices. To this end a spreadsheet model was developed to analyze the impact on costs of variations in resource utilization rates. Building and using the model involves 3 steps:

1. Develop a set of hypothetical, but representative (realistic), data regarding faculty resources, their compensation, and their utilization rates for two types of institutions (one that has access to teaching assistants and one that does not).

2. Mathematically interrelate these elements in such a way that it is possible to observe the impact on costs of changing the way faculty are utilized at the lower-division level.

3. Using the data and the interrelationships, examine the effects of several policy options for assigning faculty to lower-division instruction.

Results

Table 1 shows the results of running the first model for public institutions. As shown in the table, institutions are disaggregated into four types, following the classification system used in Higher Education Financing in the Fifty States (see Appendix A). The data on enrollments, which represent fiscal year 1982, are taken from that document, as are the data on instructional expenditures per student. The latter, which are fiscal 1982 data in the document, have been increased by 26 percent (6 percent compounded over four years) as a means of expressing expenditures in estimated 1986 dollars.

Table 1. Expenditures Model for Estimating the Cost of Frontloading

	Type of Public Institution			
	Bacca-laureate	Compre-hensive	Doctoral Non Medical	Research Non Medical
Instructional Exp's Per FTE Student	$2,379	$2,817	$3,207	$3,561
Number of FTE Students				
Lower Division	1,500	3,623	6,607	8,434
Upper Division	669	2,174	4,585	7,122
Graduate	46	527	1,888	2,811
Total	2,215	6,324	13,079	18,368
Expenditure Ratios				
Upper : Lower	1.44	1.41	1.48	1.65
Graduate : Lower	1.73	2.02	3.15	3.45
-- Interim Result --				
Expenditures Per Student				
Lower-Division	$2,072	$2,297	$2,171	$2,191
Upper-Division	$2,983	$3,245	$3,204	$3,608
-- Final Result --				
If the difference between lower- and upper-division per-student costs is reduced				
By One-Fourth:				
Additional Exp's	$341,724	$859,130	$1,706,859	$2,988,674
% of instruction	6.5%	4.8%	4.1%	4.6%
% of total E&G	2.7%	2.2%	1.8%	1.5%
By One-Half:				
Additional Exp's	$683,449	$1,718,260	$3,413,719	$5,977,348
% of instruction	13.0%	9.6%	8.1%	9.1%
% of total E&G	5.4%	4.4%	3.5%	3.0%
By Three-Fourths:				
Additional Exp's	$1,025,173	$2,577,390	$5,120,578	$8,966,022
% of instruction	19.5%	14.5%	12.2%	13.7%
% of total E&G	8.1%	6.6%	5.3%	4.5%
Entirely:				
Additional Exp's	$1,366,897	$3,436,520	$6,827,438	$11,954,696
% of instruction	25.9%	19.3%	16.3%	18.3%
% of total E&G	10.9%	8.8%	7.0%	6.0%

The policy options tested in the model represent different degrees of closing the gap between per student expenditures for lower- and upper-division instruction. Expenditures for the upper division are held constant in the model, while expenditures for lower division are increased in increments amounting to 25 percent of the original difference in expenditures (per student). At public baccalaureate institutions (Table 1), for instance, the current difference in per student expenditures is $911, comparing upper to lower division. If that difference is halved, so that per student expenditures in lower division rise from $2072 to $2528, the effect on total expenditures is an increase of $683,449, or 13 percent of current toal expenditures for instruction and 5.4 percent of total educational and general (E&G) expenditures.

The results, then, are a function of the original extent of instructional expenditures per student, the proportion of students at the lower-division level, and the expenditure ratios. All the effects save one are positive. That is, they drive up the costs of frontloading when they themselves increase. The one exception is the expenditure ratio for graduate students. The higher it goes, the less the amount of money being spent at the undergraduate level. For research universities without medical programs, for instance, if the expenditure ratio were set at 4.45 rather than 3.45, the net result would be a decrease of about $500,000 in the amount of additional expenditures for frontloading at the 50 percent level of closing the resource gap between the two levels of undergraduate instruction.

Since the cost ratios, while based on empirical evidence, are estimates and not facts, it is appropriate to more systematically analyze the sensitivity of the results to variations in the cost ratios. The analysis is shown in Table 2,

Table 2. Sensitivity Analysis of the Estimated Costs of Frontloading

	Type of Public Institution			
	Bacca-laureate	Compre-hensive	Doctoral Non Medical	Research Non Medical
A 10% increase in U:L results in this change in the cost of frontloading*	$210,883	$553,250	$1,004,226	$1,369,901
--as a percent of the original estimate	30.9%	32.2%	29.4%	22.9%
A 10% increase in G:L results in this change in the cost of frontloading*	($2,373)	($25,756)	($112,883)	($229,558)
--as a percent of the original estimate	-0.3%	-1.5%	-3.3%	-3.8%

*Assuming a 50 percent reduction in the gap between upper and lower-division costs per student.

where the effects of an increase of 10 percent in the cost ratios (for example, from 1.44 to 1.58) are recorded. The cost of frontloading is far more sensitive to U:L than to G:L. This is helpful with respect to the soundness of the model because the degree of variance in the estimates of U:L is relatively small compared to the estimates of G:L.

Tables 3 and 4 are the same as Tables 1 and 2, respectively, except that they show figures for private rather than public institutions. The costs of frontloading at the private institutions are much smaller. Across the various types of institutions, they range from about 37 to 47 percent as large as those at public institutions. This is true despite the fact that overall cost per student at private institutions is higher. The reason why frontloading costs are less at the private institutions is that they have much smaller lower-division enrollments. Conversely, among the reasons why their overall costs per student are high relative to public institutions is that they are more likely to suffer (in an economic sense) from diseconomies of scale and to enroll a much higher proportion of graduate students (Brinkman, 1981).

While it has come to be widely accepted that student involvement in collegiate life is positively related to retention, there are no quantitative relationships established that would indicate the extent to which retention might be improved by adding resources to lower-division instruction. To indicate what might happen, and to show the consequences for increased revenues in the year following the deployment of those additional resources, we make the simple assumption that for each 25 percent that the discrepancy between expenditures per student at the upper and lower division is reduced (by increasing lower-division expenditures), the attrition rate drops one percentage point for both year-one to year-two, and year-two to year-three

Table 3. Expenditures Model for Estimating the Cost of Frontloading

	Type of Private Institution			
	Bacca-laureate	Compre-hensive	Doctoral Non Medical	Research Non Medical
Instructional Exp's Per FTE Student	$2,615	$3,119	$3,517	$8,663
Number of FTE Students				
Lower Division	657	1,317	3,065	1,866
Upper Division	394	887	2,209	1,702
Graduate	22	572	1,639	1,921
Total	1,073	2,776	6,913	5,489
Expenditure Ratios				
Upper : Lower	1.44	1.41	1.48	1.65
Graduate : Lower	1.73	2.02	3.15	3.45
-- Interim Result --				
Expenditures Per Student				
Lower-Division	$2,222	$2,325	$2,116	$4,211
Upper-Division	$3,200	$3,285	$3,123	$6,936
-- Final Result --				
If the difference between lower- and upper-division per-student costs is reduced				
By One-Fourth:				
Additional Exp's	$160,605	$315,996	$771,690	$1,271,221
% of instruction	5.7%	3.7%	3.2%	2.7%
% of total E&G	2.4%	1.8%	1.5%	0.8%
By One-Half:				
Additional Exp's	$321,210	$631,991	$1,543,381	$2,542,443
% of instruction	11.4%	7.3%	6.3%	5.3%
% of total E&G	4.8%	3.5%	3.0%	1.6%
By Three-Fourths:				
Additional Exp's	$481,814	$947,987	$2,315,071	$3,813,664
% of instruction	17.2%	11.0%	9.5%	8.0%
% of total E&G	7.3%	5.3%	4.5%	2.4%
Entirely:				
Additional Exp's	$642,419	$1,263,982	$3,086,762	$5,084,885
% of instruction	22.9%	14.6%	12.7%	10.7%
% of total E&G	9.7%	7.1%	5.9%	3.2%

Table 4. Sensitivity Analysis of the Estimated Costs of Frontloading

	Type of Private Institution			
	Bacca-laureate	Compre-hensive	Doctoral Non Medical	Research Non Medical
A 10% increase in U:L results in this change in the cost of frontloading*	$86,779	$188,600	$422,771	$569,950
--as a percent of the original estimate:	27.0%	29.8%	27.4%	22.4%
A 10% increase in G:L results in this change in the cost of frontloading*	($960)	($18,994)	($66,380)	($140,854)
--as a percent of the original estimate:	-0.3%	-3.0%	-4.3%	-5.5%

*Assuming a reduction of 50 percent in the gap between upper and lower-division costs per student.

transitions. We assume further that the same attrition rate (on a cohort basis) applies to all institutions: 25 percent from year one to year two, and 20 percent from year two to year three. A 50 percent closing of the gap, then, would lower the attrition rates to 23 percent and 18 percent, respectively. The results for additional revenues calculated on the basis of assessed tuition revenue per student data by type of institution are shown in Table 5. Note that the additional students flowing from increased retention are not rolled back into the model on the cost side. In instances where additional students could not be absorbed by current staff and facilities, they would in turn lead to additional expenditures. Also note that subtracting assessed tuition revenue from expenditures does not yield a true net expenditure figure for frontloading, because many students pay less than the assessed tuition.

We turn now to the second model, in which we focus on faculty rather than on expenditures directly. Two versions of the model were run. One for large universities having access to teaching assistants, and one for small comprehensive institutions with little access to such assistants.

The model is shown in the ensuing pages in the form of a spreadsheet template. Although the connecting formulas are not shown, the tables should make it possible to follow what is a straightforward model. In Table 6A, the distribution of current faculty is shown for lower division and upper division instruction. The distribution is hypothetical, but based on actual data for a research (non-medical) university. The compensation data for ranked faculty are averages for a category I institution for 1984-85 (AAUP, 1985) increased by 6 percent to estimate 1985-86 values. Compensation for a FTE lecturer or teaching assistant is an estimate based on one research university's data.

Table 6A. Current Staff

FTE Staff	Lower	Upper	Total	Average Compensation
Professors	98.0	211.0	309	$54,272
Associate Professors	92.0	101.0	193	$40,492
Assistant Professors	70.5	75.0	145.5	$33,793
Instructors	9.0	3.5	12.51	$25,217
Total with rank	269.5	390.5	660.0	
Lecturers, TAs	114.1	54.4	168.45	$20,000
Total FTE Staff	383.6	444.86	828.46	

Table 6B. Other Current Inputs

Non-Staff Inputs (in thousands of $'s)	Lower	Upper
Support Staff	$3,350	$4,745
Operating Supplies	$1,090	$1,600
Capital	$100	$100

Table 6C. Current Student-Faculty Ratios

Type of Faculty	Lower	Upper
Professors	86.1	33.8
Associate Professors	91.7	70.5
Assistant Professors	119.6	95.0
Instructors	937.1	2029.1
Total with rank	31.3	18.2
Lecturers, TAs	73.9	131.0
Total faculty	22.0	16.0

Table 5. Estimated Assessed Tuition Revenue Resulting from Frontloading

Reduction in gap between upper and lower-division costs per student	Public Institutions: Baccalaureate	Comprehensive	Doctoral Non Medical	Research Non Medical
25%	$15,987	$37,642	$93,399	$130,255
50%	$32,180	$75,766	$187,909	$262,179
75%	$48,577	$114,372	$283,658	$395,774
100%	$65,180	$153,462	$380,605	$531,038
	Private Institutions			
	Baccalaureate	Comprehensive	Doctoral Non Medical	Research Non Medical
25%	$28,499	$52,566	$157,775	$157,297
50%	$57,364	$105,805	$317,572	$316,610
75%	$86,594	$159,719	$479,392	$477,940
100%	$116,190	$214,306	$643,235	$641,286

Table 6B shows hypothetical values for non-faculty resources, again reflecting in a general way the experiences of a research university. These values will vary as a function of changes in the number of faculty assigned to lower-division instruction.

The lower- and upper-division enrollment for the model institution are average values for an institution of this type (see Table 1, research universities without medical). These enrollment figures divided by the faculty numbers in Table 6A lead to the student-faculty ratios shown in Table 6C. The combination of cost figures and enrollment generate the cost-per-student data in Table 6D. Note that the total costs per student by level and the cost ratio (U:L) are identical to the values for this type of institution shown in Table 1. The compensation and employment data from Table 6A and the other expenditure data from Table 6B are combined to produce the overall expenditure data by level shown in Table 6E.

Table 6F contains an example of a policy option. For the option shown, the faculty cadre assigned to upper-division instruction does not change, but the number of faculty assigned to lower-division instruction is increased. For each type of faculty the number is increased (decreased) so that the resulting student-faculty ratio is the average of the current ratios for lower and upper division--splitting the difference in other words. The result of this policy in terms of additional staff is shown in Table 6G. Note that in model 2 the number of some types of faculty (instructors, lecturers, and teaching assistants) at the lower-division level are reduced, as the emphasis shifts toward senior faculty. This strategy is partly responsible for the difference in the cost of frontloading between model 1 and model 2.

Table 6D. Current Cost Per Student By Level

Staff	Lower	Upper	U/L
Professors	$631	$1,608	2.55
Associate Professors	$442	$574	1.30
Assistant Professors	$282	$356	1.26
Instructors	$27	$12	0.46
Total: ranked faculty	$1,382	$2,550	1.85
Lecturers, TAs	$271	$153	0.56
Support Staff	$397	$666	1.68
Total for all staff	$2,049	$3,369	1.64
Operating Expenses	$129	$225	1.74
Capital	$12	$14	1.18
Total Cost Per Student	$2,191	$3,608	1.65

Table 6E. Current Total Cost (000's)

Staff	Lower	Upper	Total
Professors	$5,319	$11,451	$16,770
Associate Professors	$3,725	$4,090	$7,815
Assistant Professors	$2,382	$2,534	$4,917
Instructors	$227	$89	$315
Total: ranked staff	$11,653	$18,164	$29,817
Lecturers, TAs	$2,282	$1,087	$3,369
Support Staff	$3,350	$4,745	$8,095
Total: all staff	$17,285	$23,996	$41,281
Operating Expenses	$1,090	$1,600	$2,690
Capital	$100	$100	$200
Total	$18,475	$25,696	$44,171

Table 6F. Alternative Student-Faculty Ratios

Type of Faculty	Lower	Upper	Policy
Professors	59.9	33.8	Resources are assigned to Lower Division instruction on the basis of student-faculty ratios that are equal to the average of those currently assigned to Lower and Upper Division
Associate Professors	81.1	70.5	
Assistant Professors	107.3	95.0	
Instructors	1483.1	2029.1	
Total with rank	24.8	18.2	
Lecturers, TAs	102.5	131.0	
Total faculty	19.0	16.0	

Table 6G. Alternative Distribution and Size of Faculty

Type of Faculty	Lower	Upper	Total	New
Professors	140.8	211.0	351.8	42.8
Associate Professors	104.0	101.0	205.0	12.0
Assistant Professors	78.6	75.0	153.6	8.1
Instructors	5.7	3.5	9.2	-3.3
Total with rank	329.1	390.5	719.6	59.6
Lecturers, TAs	82.3	54.4	136.7	-31.8
Total faculty	411.4	444.9	856.2	27.8

The result in terms of additional expenditures is shown in Table 6H. For the sample data, the value is $2,616,000. The algorithms for several additional expenditures occurring at the lower-division level are not obvious from the tables. Operating expenditures increase from $1,090,000 (Table 6B) to $1,120,000 (Table 6H), as a result of adding $500 for each additional ranked faculty. Support-staff expenditures increase $223,000, on the assumption that one additional individual would be hired for every four new ranked faculty, at $15,000 each. Plant expenditures of $55,000 are added based on the assumption that each new ranked faculty would require 200 gross square feet of space and each new support staff would require 120 gross square feet, both at $4 per square foot. With respect to the faculty themselves, it is assumed that any new faculty will be hired at the average compensation rate for their rank.

The term "net cost" in Table 6H is put in quotation marks to emphasize that this figure is not an estimate of true net costs, but only of the estimated additional expenditures minus an estimate of the offset from assessed tuition. To determine true net costs, one would need to know net tuition revenue, a figure which depends on many institution specific factors, and one that was considered not worth estimating for present purposes. The tuition revenue model, without formulas, is shown in Table 6I. It is assumed that halving the differences in student-faculty ratios will decrease attrition by two percentage points in the year-one to year-two and year-two to year-three transitions. If the difference is removed entirely, the attrition rates are assumed to drop by four percentage points each.

If this model is run for a public research university (non-medical) under the policy option that student-faculty ratios at the lower-division level will be made identical to those at the upper-division level, the result is additional

Table 6H. Alternative Total Cost (000's)

Staff	Lower	Upper	Total
Professors	$7,641	$11,451	$19,092
Associate Professors	$4,211	$4,090	$8,301
Assistant Professors	$2,656	$2,534	$5,191
Instructors	$143	$89	$232
Lecturers, TAs	$1,646	$1,087	$2,733
Support Staff	$3,573	$4,745	$8,318
Operating Expenses	$1,120	$1,600	$2,720
Capital	$100	$100	$200
Additional Plant Exp's	$55	$0	$55
Total Cost of Alternative	$21,091	$25,696	$46,787
- Current Costs	$18,475	$25,696	$44,171
= Additional Costs	$2,616	$0	$2,616
+ Assessed Tuition Revenue from Increased Retention			$415
= "Net" Cost of Frontloading			$2,201
% of Current Undergraduate Instructional Exp's			5.0%
% of Current Total Instructional Exp's			3.4%
% of Current Educational and General Exp's			1.1%

Table 6I. Students and Related Revenue by Level

	Lower	Upper
FTE Students	8,434	7,122
Tuition per FTE student	$1,675	$1,675

Attrition Data:	Current	Estimated
first year rate	0.25	0.23
second year rate	0.2	0.18
Class Sizes		
1st year	4819	4819
2nd year*	3615	3711
3rd year*	2892	3043
Three year total	11326	11573
Additional students		248
Additional tuition revenue (in first year of additional expenditures)		$414,929

*based on cohort and retention rate

expenditures of $9,682,000 with a tuition revenue offset of $836,000. If the model is run for a public comprehensive institution (enrollment as in Table 1), with appropriate (empirically based) staff allocations, compensation and other expenditures, the additional expenditures generated by the first policy option--splitting the difference in student-faculty ratios between lower and upper division--are $1,087,000 with a $124,000 tuition revenue offset. The policy option of equalizing student-faculty ratios between the two levels results in estimated additional expenditures of $3,010,000 offset by $250,000 in additional revenue from tuition.

Conclusion

Obviously, the cost of frontloading is a function of the extent of frontloading, that is, the extent to which additional resources are assigned to lower-division instruction. The models and calculations presented above provide some idea of the range of possible costs given the likely range of conceivable policy options. In general, the costs are substantial yet modest when considered as a percent of current expenditures. The 50 percent option in model 1, for instance, which would certainly constitute a major reassignment of resources and one that ought to have a significant positive impact on the educational experience of lower-division students, typically would add only about 10 percent to the instructional budget--less than 5 percent to the E&G budget--even without offsetting increases in tuition revenue. It would seem that such increments are within the realm of the feasible, especially if they were accomplished over several years.

The perspective offered by model 2 is even more encouraging. Focusing on faculty, the model shows that the exposure of lower-division students to senior faculty can be significantly increased for relatively modest amounts of

additional expenditures. An increase of a few percent in the current instructional budget could provide lower-division students with educational experiences much closer to those normally provided to upperclassmen.

In short, the greater involvement in learning sought by the Study Group would seem to be attainable without anything like an order of magnitude increase in current funding levels. Indeed, it may well be that over the next few years just maintaining current levels of base funding (relative to inflation) could provide the necessary resources at many institutions. If the long awaited decline in enrollment finally does occur, and especially if it starts at the lower-division level as we might expect, then maintaining current overall resources will make possible a richer distribution of resources to lower division. Of course, there is no guarantee that institutions would allocate resources in the manner required, i.e., they might elect to put the "excess" resources into something other than lower-division instruction.

Appendix A

The criteria used in classifying institutions by the categories shown in Tables 1-5 are as follows:

Research Universities

These institutions are characterized by a significant level of activity in and commitment to doctoral-level education as measured by the number of doctorate recipients and the diversity in doctoral program offerings, and by a significant level of research activities. To be classified as a research university, an institution must grant a minimum of 30 doctoral-level degrees in three or more doctoral-level program areas[1] on an annual basis or, alternatively, have an interdisciplinary program at the doctorate level. Included in the counts of doctorate degrees are the first professional degrees (M.D., D.D., D.V.M., D.D.S.). In addition to meeting the criteria on degrees, a research university must rank among the top 75 institutions in the country in research expenditures. For this study, exceptions have been made to include Rockefeller University and Georgia Institute of Technology Main Campus in this category because of their doctoral program emphasis and substantial level of research.

Universities

These institutions meet all of the criteria stated above, except they are not as extensively involved in research activities as the research universities.

[1]Programs or program areas are a major field of study as defined at the two-digit level of the HEGIS Taxonomy of Programs.

Comprehensive Institutions

These institutions are characterized by a strong, diverse postbaccalaureate program (including first professional) but do not engage in significant doctoral-level education. Specifically, this category includes institutions not considered major doctoral schools in that the number of doctoral-level degrees granted is less than 30 or in that fewer than three doctoral-level programs are offered. In addition, these institutions must grant a minimum of 30 postbaccalaureate2 degrees and either grant degrees in three or more postbaccalaureate programs, or alternatively, have an interdisciplinary program at the postbaccalaureate level.

General Baccalaureate Institutions

These institutions have, as their primary emphasis, general undergraduate, baccalaureate education. They are not significantly engaged in postbaccalaureate education. Included are institutions not considered specialized institutions, in which the number of postbaccalaureate degrees granted is less than 30 or in which fewer than three postbaccalaureate level programs are offered, but either (a) grant baccalaureate degrees and grant degrees in three or more baccalaureate programs, or (b) offer a baccalaureate program in interdisciplinary studies.

2Includes master's, doctoral, and first-professional degrees.

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